.93 S611
PUBLIC LIBRARY
SEP 5 - 1945
Technology

U. S. DEPARTMENT OF COMMERCE

Technical News Bulletin

of the

National Bureau of Standards

★ *Issued Monthly* ★

Washington **August 1945**[1] **Number 340**

CONTENTS

	Page
Cooperation with French Rubber Institute	59
Crystallization phenomena in rubber	59
Mass spectrometric analyses of hydrocarbons	60
Heat of polymerization of styrene	60
Heats of combustion and isomerization of alkylbenzenes	60
Fire tests of tempered glass	61
Effect of heat on portland cements containing Vinsol resin	61
Scum formations on terrazzo and marble	61
Effects of combined stresses and low temperatures on the mechanical properties of nonferrous metals	62
Thin-walled aluminum Geiger-Müller counters	62
Spectrographic steel standard samples	62
Method of Lagrangian curvilinear interpolation	63
Coefficients for numerical integration without differences	63
Airplane landing lights	63
Simplified practice in peacetime	63
New and revised publications issued during July 1945	64
Mimeographed material: Letter Circulars	64
Recent articles by members of the Bureau's staff published in outside journals	64

COOPERATION WITH FRENCH RUBBER INSTITUTE

The French Government, before the war, utilized a portion of the income received from the export tax on plantation rubber from Indo-China to set up a research institute, the Institut Francais du Caoutchouc, in Paris. At the time of its establishment in 1937, a thorough study of American research on rubber was made by Jean Le Bras, who spent several months in this country, including about a week at the Bureau. At that time Dr. Le Bras became acquainted with members of the Rubber Section, two of whom visited the laboratories of the French Institute in Paris in 1938. Dr. Le Bras is now again in the United States with the French Mission of Industrial Production. He has been spending considerable time at the Bureau in a study of developments in this country during the period 1940–45. The research activities at the Institute, under the direction of Dr. Le Bras, continued without much diminution during the entire period of German occupation. Attention was limited to natural rubber, with special emphasis on aging and antioxidants. Two training courses have been established by the Institute, one for young men who wish to work in industrial positions in rubber technology and the other for those who wish to obtain employment on the rubber plantations in Indo-China. The Institute has also taken over the publication of the French rubber journal "Revue Generale du Caoutchouc."

CRYSTALLIZATION PHENOMENA IN RUBBER

An article on crystallization in natural and synthetic rubbers has been prepared by Leonard A. Wood of the Bureau for publication as a chapter in the book entitled "Advances in Colloid Science," now being edited by H. Mark and G. S. Whitby. As Dr. Wood explains, crystallization may be studied by a number of different methods. These include volume changes, thermal measurements, X-ray diffraction, optical double refraction, light transmission, and a study of mechanical properties such as modulus and hardness, or those evident in flow. Crystallization may occur in natural rubber, balata, gutta-percha, chloroprene polymers (Neoprene), organic polysulfides (Thiokol), isobutene polymers (Vistanex and Butyl rubber), polyethylene, and in vinylidene chloride polymers and co-

[1] Published with approval of the Director of the Budget.

660110—45

polymers (Saran). Experimental results, together with a certain amount of interpretation, are presented regarding rate of crystallization, melting of crystals, change of melting range with temperature of crystallization, recrystallization, fraction of material in the crystalline state, and the effects of vulcanization on crystallization. Although a certain emphasis is placed on work carried out at the Bureau, the chapter is intended as a summary of the field and contains over 140 references to the literature.

MASS SPECTROMETRIC ANALYSES OF HYDROCARBONS

The analyses of complex hydrocarbon mixtures can be made on the mass spectrometer with a high degree of precision. As explained by A. Keith Brewer and V. H. Dibeler in the August Journal of Research (RP1664), the basis for the analyses lies in two parenthetic facts: First, that molecules of all hydrocarbons when bombarded by 50- to 100-volt electrons are not only ionized but are broken down into every possible disintegration fragment; and second, that while the appearance ratios of these fragments is always the same for a given hydrocarbon, the ratios are never the same for different hydrocarbons.

A mass spectrometer record for any hydrocarbon consists of a series of peaks, the heaviest being for that of the normal molecule, whereas the rest of the peaks are for the various possible fragments resulting from a loss of hydrogen atoms or C atom groups. The mass spectrometer record for a mixture of hydrocarbons is the sum of the peaks for the various constituents wherein each contributes in exact proportion to the amount present in the mixture. The analysis of such a composite record consists in subtracting the contributions of each possible constituent. Mixtures containing over 20 compounds have been precisely analyzed at the Bureau.

The agreement of results of individual analyses is high. Almost invariably independent analyses will agree to within a few tenths to a few thousandths of 1 percent for the concentration of each component. The absolute accuracy, however, may or may not be as great as the reproducibility. While accuracy is principally dependent on the agreement between analyses, it is also dependent on the purity of the materials used for calibration and on a number of other factors, which are not necessarily constant from day to day. In test analyses where the composition of the sample is known, the precision has been found to agree to within the limits of uncertainty in the sample.

The mass spectrometer uses about 0.01 milliliter of gas during an analysis. Although the smallness of sample required is often of great help, it does introduce a complication in the taking of representative samples. Indeed it is often evident that the reproducibility of the instrument is limited materially by nonuniformities in the sample.

HEAT OF POLYMERIZATION OF STYRENE

Polystyrene, an important wartime plastic, is made by polymerizing liquid, monomer styrene, and synthetic rubber, GR-S, is made by polymerizing this same monomer styrene with 1,3-butadiene. In polymerization, individual molecules of the monomer are joined end to end to form very long polymer-molecules. Much heat is evolved in this polymerization, and in the industrial process, plant equipment must be designed for the removal of this heat to permit proper control. Until now, the heat evolved when styrene polymerizes, that is, the heat of polymerization, had not been carefully determined and values in use for it ranged from 15 to 20 kilocalories per mole of monomer styrene. The heat has now been measured in two different laboratories of the Bureau by different methods, and the results are in agreement to 0.2 kcal. The value obtained for the heat of polymerization is 17.3 kcal if the polymer is formed in solution of the monomer, and 16.5 kcal if dry polymer is formed. The difference, 0.8 kcal, is the heat of solution of polystyrene in monomer. In one laboratory the heat of polymerization was measured by determining the difference between the heat of combustion of dry polystyrene and liquid monomer styrene. In the other laboratory, the heat of polymerization was determined directly by measuring the rise in temperature of the styrene as it polymerized in an apparatus under conditions that prevented the escape of any heat.

HEATS OF COMBUSTION AND ISOMERIZATION OF ALKYLBENZENES

In the August number of the Journal of Research (RP1665), new experimental data on the heats of combustion and isomerization of the eight C_8H_{12} alkylbenzenes are reported by Walter H.

Johnson, Edward J. Prosen, and Frederick D. Rossini of the Bureau's thermochemical laboratory.

The heats of isomerization of the eight C_9H_{12} alkylbenzenes were determined by measuring the ratios of the heats of combustion in the liquid state of purified samples of these compounds by use of the procedure previously described for the hexanes, heptanes, and octanes. The data yield the following values for the heat of isomerization in the liquid state at 25° C., $\Delta H°$, of *n*-propylbenzene into each of the C_9H_{12} alkylbenzenes, in kcal/mole: *n*-propylbenzene, 0.00; isopropylbenzene, −0.67 ±0.16; 1-methyl-2-ethylbenzene, −1.93 ±0.16; 1-methyl-3-ethylbenzene, −2.48 ±0.19; 1-methyl-4-ethylbenzene, −2.74 ±0.26; 1,2,3-trimethylbenzene, −4.83 ±0.22; 1,2,4-trimethylbenzene, −5.61 ±0.16; 1,3,5-trimethylbenzene, −6.00 ±0.26. These data were combined with the value previously reported for the heat of combustion of *n*-propylbenzene to obtain values for the heats of combustion of each of the C_9H_{12} alkylbenzenes in the liquid state at 25° C.

FIRE TESTS OF TEMPERED GLASS

Tempered or case-hardened plate glass is preferred to untempered glass in many locations on account of greater strength, and also to wired glass on the score of appearance. Although not intended for use in fire protectives for openings in the same manner as wired glass, the reaction of tempered glass to fire exposure is of interest from the standpoint of hazard from flying fragments.

Tests at the Bureau indicated that plain glass will begin to fracture as soon as the flame touches it, with jagged pieces falling out without scattering. Tempered glass cracks suddenly after few minutes of fire exposure into small granular pieces without sharp edges that are projected to considerable distances. In the case of wired glass, although it cracks, no pieces are dislodged and it remains as a fire barrier for 30 minutes or more of fire exposure until it melts, softens, or sags under its own weight.

EFFECT OF HEAT ON PORTLAND CEMENTS CONTAINING VINSOL RESIN

The use of air-entraining cements is rapidly increasing, principally because of their superior resistance to freezing and thawing. One agent commonly used to produce air entrainment is Vinsol resin. Some mills have experienced considerable loss of resin while grinding the flake or powdered material with clinker. This has occurred most frequently when high temperatures (around 300° F.) existed. Leonard Bean and Albert Litvin, of the Bureau, have conducted a study of the effect of heat on Vinsol resin and on its air-entraining properties. Vinsol resin was found to carbonize on heating at 300° F. Heating cement containing the resin for 48 hours at that temperature volatilized as much as two-thirds of the resin and reduced the air entrained by mortars made from the cement. Also, the methoxyl content of Vinsol resin was found to be reduced by heating at 300° F. Heating takes place in the finish grinding of commercial cements, and temperatures of over 250° F. may be found after many days of storage. Methods of determining Vinsol resin are discussed.

SCUM FORMATIONS ON TERRAZZO AND MARBLE

The formation of scums on terrazzo floors and marble shower stalls has been studied to determine the cause and means of prevention. Terrazzo and marble were treated with soap and with soap followed by hard water until 50 applications had been made. Then the films were scraped off into clean test tubes and shaken up with distilled water. Those scums made by repeated films of soap, dissolved completely and showed that no insoluble soap had been formed. Those made by soap applications, followed by three of hard water, floated on top of the water and imparted no opalescence, showing that they had been converted completely to insoluble soap. The one on terrazzo treated with hot water formed a thicker film of insoluble soap.

These tests seem to show that the scums formed on marble shower stalls and terrazzo floors are due entirely to the hard water acting on old soap films and that the lime dissolved from the material in the stall or floor is not sufficient to cause scums. They can probably be prevented by either of two means: (1) Use only soft water, or (2) Do not leave soap films on the material. As soap is less soluble in cold water than in hot, it would be more satisfactory to rinse with cold water where hard water must be used for this purpose. It may be inferred that canvas curtains, as used for shower enclosures as well as most other materials, would be affected with scums

if soap is allowed to dry on them and later sprayed with hard water.

EFFECTS OF COMBINED STRESSES AND LOW TEMPERATURES ON THE MECHANICAL PROPERTIES OF NONFERROUS METALS

By means of tension tests of notched specimens, D. J. McAdam, Jr., G. W. Geil, and B. W. Mebs have investigated the mechanical properties of K-Monel metal, nickel, plain and leaded phosphor bronzes, commercial aluminum, and high-purity aluminum. Diagrams have been drawn to show the influence of notches and of the stress system on resistance to plastic deformation, resistance to fracture, and ductility between room temperature and —188° C.

The quantitative variation of mechanical properties with temperature has also been studied. For the above mentioned metals, the ductility does not decrease with decrease of temperature to —188° C.

The correlation between ductility and stress-temperature lines for yield stress, ultimate stress, and initial technical cohesion limit is discussed in a paper that has been prepared for publication in the Transactions of the American Society for Metals.

THIN-WALLED ALUMINUM GEIGER-MULLER COUNTERS

Geiger-Müller tube counters, consisting of an insulated wire mounted axially in a metal tube that is maintained at a potential several hundred volts from that of the wire, are useful in the measurement of beta radiation from radioactive substances. The tube counter is sensitive to very low intensities of beta radiation as it records each beta particle that passes through it by producing an electric pulse that can be amplified and registered. The application of Geiger-Müller tube counters to the measurement of beta rays is restricted by the fact that beta rays with energies as high as 1,000,000 volts can penetrate only a fraction of an inch of ordinary materials. This means that the counter tubes must have walls which are very thin and of low density. Most previous attempts to achieve this have been laborious and expensive as the tube counter must be gastight. By using methods to plate thin layers of copper on commercially available aluminum tubes, such as are used for toothpaste, Burrell W. Brown and L. F. Curtiss have found it possible to make very excellent thin-walled counters by soldering a metal plug in the open end of the aluminum tube. As described in the Journal of Research for August (RP1666), these plugs support the insulators and glass tube for filling and sealing. The walls are only 0.004 inch in thickness, which permits most beta rays to pass through and be recorded. Counters made in this way are relatively inexpensive.

SPECTROGRAPHIC STEEL STANDARD SAMPLES

The following changes in the status of the Bureau's spectrographic steel Standard Samples should be noted before ordering:

1. *A Nickel-Molybdenum Steel (SAE 4620)* is now being issued in two sizes, namely, standard 419, 7/32-inch rod, and standard 819, ½-inch rod, with the following percentage composition: Mn 0.72, Cu 0.80, Si 0.27, Ni 1.71, Cr 0.24, Mo 0.22, and Sn 0.009. The price per sample is $3.00.

2. *An Open Hearth Ingot Iron* is now being issued in two sizes, namely, standard 420, 7/32-inch rod, and standard 820, ½-inch rod, with the following percentage composition: Mn 0.020, Cu 0.050, Ni 0.020, Cr 0.006, Co 0.007, Mo 0.002, Al 0.002, and Su 0.005. The price per sample is $3.00.

3. Attention is called to the certification of values for *low concentrations of aluminum and tin* in samples previously issued; a summary of standards certified for these elements is given in the following table.

Standard Sample Number	Aluminum	Standard Sample Number	Tin
	Percent		*Percent*
403, 803	0.005	412, 812[a]	0.026
406, 806	.023	414, —	.014
407, 807	.055	417, 817	.020
414, —	.020	419, 819	.009
416, 816	1.06	420, 820	.005
417, 817	.013		
420, 820	.002		

[a] Sample 812 is now out of stock, but the certified tin value will apply to the samples previously issued.

CAUTION: For the determination of small amounts of aluminum, the use of aluminum-base abrasives in cleaning and shaping the rods must be avoided and the outer cylindrical surface of the 7/32-inch standards must be removed to a depth of 0.002 inch.

A general certificate of analysis of steel standards revised to include the new standards, other than boron steels, is furnished with each shipment.

4. *Out of Stock.* Of the standards originally issued, 810, 811, and 812 are out of stock and cannot be supplied.

METHOD OF LAGRANGIAN CURVILINEAR INTERPOLATION

In the August number of the Journal of Research (RP 1667), William J. Taylor, of the American Petroleum Institute's Research Project 44 at the Bureau, describes a simplified method of computing Lagrangian coefficients for curvilinear interpolation. This method may be used when tables of Lagrangian coefficients are not available or when tables are available, but the coefficients are not tabulated for the exact fraction of the interval to which the interpolation is to be made.

COEFFICIENTS FOR NUMERICAL INTEGRATION WITHOUT DIFFERENCES

The latest publication in the series of mathematical tables sponsored by the Bureau gives the coefficients for numerical integration without differences. When a function $f(x)$ is known for n equally spaced arguments at interval h, the value of the integral between the limits of x_0+rh and x_0+sh may be obtained by integrating the well-known Lagrangian interpolation formula when the latter is written in such a form that $[x]$ denotes the largest integer in x. and $B_i^{(n)}(p)$ are polynomials of the nth degree. The present table gives the value of these polynomials $B_i^{(n)}(p)$ to 10 decimals, for p ranging from $-[(n-1)/2]$ to $[n/2]$. For $n=3$, 4, and 5 these polynomials are tabuated at intervals of 0.01; for $n=6$ and 7, they are tabulated at intervals of 0.1. Copies of this table, which has been designated MT33, in the form of reprints from the February 1945 number of the Journal of Mathematics and Physics, are obtainable from the National Bureau of Standards, Washington 25, D. C. at 25 cents each.

The complete list of the mathematical tables available to the public (Letter Circular LC777) is obtainable without charge from the Bureau.

AIRPLANE LANDING LIGHTS

A paper prepared by F. C. Breckenridge and C. A. Douglas for publication in the Transactions of the Illuminating Engineering Society traces the history of the lights used to aid airplane pilots in landing, from the signal flares employed by the Army during the first World War to the latest proposals still awaiting development. Although primarily concerned with the joint work of the Civil Aeronautics Administration and the Bureau, the contributions of Wright Field and other agencies are mentioned when they are needed to complete the picture. Details of laboratory and field tests on semiflush contact lights, neon approach lights, the 1939 Bartow approach-light system, and the 14-inch and 18-inch course lights used as comparison lights, are included with illustrations.

The conclusions reached as the result of many tests at the Bureau have been emphasized and, with them as a basis, a program has been suggested, with a view to furthering urgently needed coordinated research by the Army, Navy, and Civil Aeronautics Administration.

SIMPLIFIED PRACTICE IN PEACETIME

A trend toward resumption of direct relationship between the Bureau and industry in the matter of simplification of sizes and varieties of manufactured products, which became apparent in the fourth quarter of last year, has continued. The War Production Board incorporated simplified practice in many limitation and conservation orders for the specific purposes of increasing output of manufactured articles needed for the war program and conserving materials and manpower. Adoption of these principles was no new experience for many industries that, prior to the war, had benefitted from the establishment of Simplified Practice Recommendations. The participation of the Bureau's personnel in adapting these Simplified Practice Recommendations to war needs is a matter of record. Numerous products that had not already passed through the Bureau's cooperative procedure, were also included in the so-called "Simplification Orders."

The fact that industry generally has gained, in a managerial sense, from its experience with mandatory simplification is evidenced by the many inquiries that the Bureau receives on how the benefits of simplification can be retained. Obviously, the Bureau is the only agency that can offer the service desired by industry in adapting wartime simplified practice to peacetime needs. The nature of this service was described in an article "Keep Simplified Practice Working," which was published in the March 1944 number of "Domestic Commerce."

Representatives of industry, while functioning on the advisory committees of the War Production Board, learned a great deal about the full benefits of practical simplification. While thus serving the war agencies, those industrial groups were impressed with the necessity for avoiding the consummation of group action without first considering the comments and views of those situated outside the group.

Industrial groups are finding that the 24-year-old procedure of the Bureau, under which all concerned participate in the formulation of voluntary Simplified Practice Recommendations, contains many desirable safeguards. They are also discovering that the Department of Commerce is in close touch with other governmental establishments that are occupied with various aspects of business activity. They are becoming aware of the mutual confidence that characterizes interdepartmental relationships, and realize that similar confidence is essential to the successful collaboration of the Federal Government and private industry in applying simplified practice during the transition from a war to a peacetime economy.

NEW AND REVISED PUBLICATIONS ISSUED DURING JULY 1945

Journal of Research [2]

Journal of Research of the National Bureau of Standards, volume 34, number 6, June 1945 (RP1656 to RP1659, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Research Papers [2]

[Reprints from April, May and June 1945 Journal of Research]

RP1645. Methods of polishing steel and their effects upon the protective value of electroplated coatings. Gerald A. Lux and William Blum. Price 10 cents.

RP1653. Methods for the evaluation of analytical filter papers. B. W. Scribner and W. K. Wilson. Price 5 cents.

RP1654. Intrinsic viscosities and osmotic molecular weights of cellulose acetate fractions. Arnold M. Sookne and Milton Harris. Price 5 cents.

RP1655. Polymolecularity and mechanical properties of cellulose acetate. Arnold M. Sookne and Milton Harris. Price 5 cents.

RP1656. Term analysis of the first two spectra of columbium. Curtis J. Humphreys and William F. Meggers. Price 25 cents.

RP1657. Diamond cutting accelerated by an electric arc. Chauncey G. Peters, Karl F. Nefflen, and Forest K. Harris. Price 10 cents.

RP1658. A transfer strain gage for large strains. Martin Greenspan and Leroy R. Sweetman. Price 5 cents.

RP1659. Refractive-index standards of fluorcrown glass. Leroy W. Tilton. Price 5 cents.

Simplified Practice Recommendation [2]

R208–45. Milk shipping cans. Price 5 cents.

Miscellaneous Publication [2]

M180. Guide-chart for carbon-brush terminals (electric) All dimensions in inches. (Size 16 by 19 inches). Price 5 cents.

Technical News Bulletin [2]

Technical News Bulletin 339, July 1945. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC793. List of commercial standards. (Supersedes LC786.)

LC794. List of simplified practice recommendations. (Supersedes LC750.)

LC795. Paint, varnish and bituminous materials: List of National Bureau of Standards publications and Federal Specifications. (Supersedes LC659.)

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS [3]

Test criterion for an incombustible material. N. P. Setchkin and S. H. Ingberg. Preprint 50, Am. Soc. Test-

[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, $3.50 a year (to addresses in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and $4.50, respectively.

[3] These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to publishers.

ing Materials (260 South Broad St., Philadelphia 2, Pa.) (June 1945).

An oscillographic method for the photometry of photographic flash lamps. T. H. Projector and L. E. Barbrow. Review of Scientific Instruments (57 East 55th St., New York 22, N. Y.) **16**, 51 (March 1945).

Bioclimatic measurements of UV-solar and sky radiation in Washington, D. C., 1941–1944. W. W. Coblentz. Bul. Am. Meteorological Soc. (Robert G. Stone, Editor, P. O. Box 2061, South Station, Arlington, Va.) **26**, 113 (April 1945).

Cellulose acetate fractions—intrinsic viscosity and osmotic molecular weight. Arnold M. Sookne and Milton Harris. Ind. Eng. Chem. (1155 16th St., N. W., Washington 6, D. C.) **37**, 475 (May 1945).

Polymolecularity and mechanical properties of cellulose acetate. Arnold M. Sookne and Milton Harris. Ind. Eng. Chem., **37**, 478 (May 1945).

Preparation of test specimens with a diamond-impregnated cutting wheel. Frank W. Reinhart. Modern Plastics (122 East 42nd St., New York 17, N. Y.) **22**, No. 10, 151 (June 1945).

Spectrographic determination of sodium, potassium, and lithium in portland cement with the direct-current carbon arc. Armin W. Helz. Paper No. 46, Portland Cement Assn. Fellowship at the National Bureau of Standards (National Bureau of Standards, Washington 25, D. C.) (February 1945).

Properties of highly hydrated dolomitic masonry limes and certain of their cement-lime mortars. G. J. Fink and Emil Trattner. Preprint A1, Am. Soc. Testing Materials (June 1945).

Pallet simplification and mass distribution. Alvin Hertwig. Packing and Shipping (Bonnell Publications, Inc., Plainfield, N. J.), **7** (June 1945); Wholesale Grocers News (176 W. Adams St., Chicago, Ill.), **27** (June 1945).

Simplification — An aid to materials handling. Alvin Hertwig. Material Movement (1125 Wolfendale St., Pittsburgh 12, Pa.), **1**, No. 1, 9 (July 1945).

U. S. GOVERNMENT PRINTING OFFICE: 1945